DESCRIPTION of the METHODS

Of producing diverſe curious CONFIGURATIONS by MEANS of

ELECTRICITY.

IN the ſeventh chapter of the fourth part of this treatiſe, mention is made of ſome configurations deſcribed by Profeſſor LICHTENBERG, of Gottingen, who firſt obſerved them upon a large electrophorus; and in the ſame chapter ſeveral experiments are related, which were made in explanation of thoſe phenomena. Since the original diſcovery of thoſe configurations by Profeſſor LICHTENBERG, diverſe methods have been contrived of producing them, and of fixing them upon paper, ſilk, reſinous ſubſtances, &c. Their various ſhapes and ramifications afford a good deal of information to the ſpeculative electrician, by ſhewing in many caſes the direction, diviſion, and quality

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lity of the electricity in a convincing and permanent manner. But independent of this ſcientific inſtruction, ſome of thoſe impreſſions are very beautiful ornaments, and as ſuch, it is not unlikely, that they may hereafter be introduced in various manufactures.

The principal method of producing thoſe impreſſions is, in general, to electrify a perfect or imperfect electric, and then to throw certain powders upon it, which will diſpoſe their particles into various forms. Thoſe powders are projected different ways, which, to avoid repetition, will be here deſcribed previous to the particular methods of forming thoſe impreſſions. The powders may be ſifted over the electrified body from a common ſieve; they may be tied up in linen rags and ſhook out of them; they may be projected by means of a bruſh *, and by means of a pair of bellows; but a more

* This may be done by taking a little of the powder between a finger and thumb, and drawing it over the bruſh, or by rubbing upon the bruſh a lump of ſome ſubſtance that is eaſily reduced into powder, ſuch as chalk, whiting, &c.

commodious

commodious method is the following: To the neck of a ſmall bottle of elaſtic gum, which is more commonly called *India rubber*, tie a tube of glaſs, wood, or metal; put the powders which you want to project, into this bottle, and then tie a double piece of flannel over the aperture of the tube. If this bottle ſo prepared be held in the hand, and be ſqueezed, by alternately opening and ſhutting the hand, the powders will be projected in a fine diffuſed manner.

As for the nature of the powders, almoſt every ſubſtance that can be pulverized ſufficiently fine, will produce ſome configurations when projected upon an electrified ſubſtance. Thus chalk, ſulphur, cinnabar, roſin, dragon's blood, gum arabic, evaporated decoctions of colouring woods, and many others, may be employed for this purpoſe either ſingle or mixed.

Exp. I. Take a pane of glaſs clean and dry, hold it ſuſpended by one corner, or lay it flat upon a table, and draw over the ſurface of it the knob of a Leyden phial, moderately

derately charged with poſitive electricity. Then lift up the glaſs, if laid upon a table, and, holding it ſuſpended, project upon it, by means of the elaſtic gum bottle, a mixed powder conſiſting of dragon's blood and gum arabic in equal parts. You will find that the two powders will be ſeparated upon the glaſs; the red powder of dragon's blood falling on certain places, and the whitiſh powder of gum arabic falling on certain other places, ſo as all together to form an oblong radiated track, conſiſting of two colours, intermixed in a thouſand odd ways *.

If inſtead of drawing the knob of the jar over the ſurface of the glaſs, you only touch the ſurface here and there with it, and then throw the mixed powder upon it as before; ſeparate ſtar-like figures will be formed about thoſe points. The ſtars,

* Having ſhewn in the 7th chap. of the 4th part, that in the act of projecting thoſe powders ſome of them acquire the poſitive, and others the negative electricity, I need not repeat, in this place, the reaſons why the dragon's blood and gum arabic take different places in this or in the following experiments.

however,

however, are better defined when a ſingle powder is projected: their rays or ramifications are ſometimes few and ſtrong, at other times many and ſlight; and frequently they don't go quite round the points on which the knob of the jar has been touched *. At A and B of fig. 6th, in the annexed plate, two of thoſe ſparks are delineated, in one of which the ramifications go quite round, but in the other they do not.

Exp. II. Repeat the preceding experiment with only this variation, viz. that now the Leyden phial be charged negatively, and the appearance of the configuration will be vaſtly different from that occaſioned by poſitive electricity. In this very few rays or branches will be obſerved; the powders moſtly diſpoſing themſelves in roundiſh ſpots, and generally a central ſpot of one powder will be ſurrounded by another powder of another colour.

* Theſe various effects depend principally on the greater or leſſer quantity of electricity contained in the Leyden phial.

Inſtead

Inſtead of dragon's-blood and gum arabic, powders of other colours may be projected upon the pane of glaſs, ſuch as powder of Pruſſian blue, ſulphur, vermilion, roſin, &c.; and thus the colours of the configurations may be varied.

Thoſe powders adhere to the glaſs rather ſlightly, viz. ſo as not to bear being touched; yet if a piece of paper be laid on the painted ſide of the glaſs without rubbing it, and the edge of it be glued all round the edge of the glaſs, the figures may be preſerved without injury. But a better method is, to lay another pane of glaſs of the ſame ſize upon the glaſs with the configurations, and to faſten them round with ſealing-wax, or a ſlip of paper paſted over both their edges.

If powders of ſuch colours as are uſed for enamel-painting, be projected upon glaſs or porcelain, and theſe ſubſtances be afterwards expoſed to a proper degree of heat in an enameller's furnace, the configurations will thereby be rendered indelible.

Exp. III. Take a piece of common writing paper, hold it very near the fire, ſo as to render it quite dry and very hot; lay it flat upon a dry marble ſlab or a very dry table, and in that ſituation draw over it the knob of a charged Leyden phial, then lift up the piece of paper by one corner, and holding it ſuſpended, project upon it the mixed powder of dragon's-blood and gum arabic by means of the elaſtic gum bottle. The configurations in this caſe are very beautiful, and may be made in various ſhapes, as of letters, ſtars, ſtripes, &c. by moving the knob of the Leyden phial in the deſired direction; but they are of one colour, viz. red; for the gum arabic being nearly of the colour of the paper, cannot be diſtinguiſhed upon it.

If the paper thus painted be held very near the fire for a few ſeconds of time, the powder of dragon's-blood, being a reſinous ſubſtance, will be melted, and faſtened to the paper; after which the powder of gum arabic may be wiped off with a handkerchief.

Powders

Powders of other colours may be projected upon the paper after the ſame manner; but unleſs they are of a reſinous nature, ſo as to be eaſily melted by heat, it is very difficult to faſten them to the paper.

A little experience will ſoon enable the operator to make thoſe impreſſions in a neat and definite manner; nevertheleſs it will be proper, before we deſcribe the other experiments, to mention ſome uſeful precautions. The charge of the Leyden phial for theſe experiments muſt be neither too high nor too low; for in the former caſe, the figure obtained will be too confuſed and irregular, and in the latter it will be too faint. In order to form a neat and well-determined figure, and to leave the reſt of the paper clean, the powders muſt not be projected perpendicularly to the paper, but the ſtream muſt be thrown in a direction parallel to the ſurface of the paper. It is alſo neceſſary to perform theſe experiments in as quick a manner as poſſible, for if the paper be ſuffered to cool too much, or the communicated

electricity to diſſipate, the deſired effect will not be obtained.

Exp. IV. Inſtead of the paper, the impreſſions may be made upon marble, by drawing the knob of the charged jar upon it, in the ſame manner as it is done upon paper. For this purpoſe, the marble muſt be made dry and hot. After the ſame manner, the configurations may be made upon all ſorts of electric or ſemi-electric ſubſtances, and they may be preſerved by covering them with a pane of glaſs, by partially melting either the reſinous plate or the powders, if they are of a proper nature; or, laſtly, by tranſpoſing them from the electric plate upon a piece of paper. But this laſt method is attended with a good deal of difficulty. I ſhall, however, (for the ſake of thoſe perſons who are not unwilling to undergo the trouble attending it) ſubjoin Mr. BENNET's method of performing it, which is very minutely deſcribed in his work on Electricity.

"To make red figures, take a pound of "raſped Brazil wood, put it into a kettle

"with as much water as will cover it, or "rather more; alſo put in about an ounce "of gum arabic and a lump of allum about "as big as a large nut, let it boil about "two hours, or till the water is ſtrongly "coloured; ſtrain off the extract into a "broad diſh, and ſet it in an iron oven, "where it is to remain till all the water be "evaporated, which with me was effected "in about twelve hours; but this depends "on the heat of the oven, which ſhould "not be ſo hot as to endanger its burning. "Sometimes I have boiled the ſtrained ex"tract till it was conſiderably inſpiſſated "before it was placed in the oven, that it "might be ſooner dry.

"When it is quite dry but not burnt, "ſcrape it out of the diſh, and grind it in a "mortar till it be finely pulverized. In "doing this, it is proper to cover the mor"tar with a cloth, having a hole through "to prevent the powder from flying away "and offending the noſe, and alſo to do it "out of doors if the weather be dry and "calm, that the air may carry away the "powder neceſſarily eſcaping, and which

" otherwiſe is very diſagreeable. When
" ground fine, let it be ſifted through muſ-
" lin or a fine hair-ſieve, returning the
" coarſer part into the mortar to be ground
" again. When the grinding and ſifting
" are finiſhed, the powder is ready for uſe.
" The reſinous plate I have moſtly uſed
" was compoſed of five pounds of roſin,
" half a pound of bees-wax, and two
" ounces of lamp-black, melted together,
" and poured upon a board ſixteen inches
" ſquare, with ribs upon the edges at leaſt
" half an inch high, to confine the compo-
" ſition whilſt fluid; thus the reſinous plate
" was half an inch thick, which is better
" than a thinner plate, the figures being
" more diſtinct. After the compoſition is
" cold, it will be found covered with ſmall
" bliſters, which may be taken out by hold-
" ing the plate before the fire, till the ſur-
" face be melted, then let it cool again, and
" upon holding it a ſecond time to the fire,
" more bliſters will appear; but by thus
" repeatedly heating and cooling the ſur-
" face, it will at laſt become perfectly
" ſmooth. Some plates were made ſmaller,
" and the reſinous compoſition confined to
" the

" the form of an ellipſis, a circle or eſcut-
" cheon, by a rim of tin half an inch broad,
" and fixed upon a board.

" The next thing to be done is to prepare
" the paper, which is to be ſoftened in wa-
" ter, either by laying the pieces upon each
" other in a veſſel of cold water, or firſt
" pouring a little hot water upon the bot-
" tom of a large diſh, then laying upon it a
" piece of paper, ſo that one edge of the
" paper may lie over the edge of the diſh,
" to remain dry, that it may afterwards be
" more conveniently taken up. Then pour
" more hot water upon its upper ſurface.
" Upon this place another piece in the ſame
" manner, again pouring on more water,
" and thus proceed till all the pieces are
" laid in. By uſing hot water, the paper
" will be more ſoftened in a few minutes
" than if it remains in cold water a whole
" day.

" When the figures are to be made, the
" reſinous plate muſt lie horizontally, whilſt
" the electricity is communicated, if the
" experiment requires any thing to be placed

" upon the plate: but it is convenient af-
" terwards to hang it up in a vertical posi-
" tion whilst the powder is projected, left
" too much powder ſhould fall where it is
" not required.

" A little of the powder may be taken
" between a finger and thumb, and pro-
" jected by drawing it over a bruſh, or,
" which is better, a quantity of powder
" may be put into the bellows and blown
" towards the plate. When the figure is
" ſufficiently covered with powder, let the
" plate be again laid horizontally upon a
" table, then take one of the ſoftened pa-
" pers out of the water by its dry edge,
" and lay it carefully between the leaves of
" a book, preſſing the book together, and
" let it lie in this ſituation about half a
" minute. Then remove the paper to a
" dry place in the book, and preſs it again
" about the ſame time, which will generally
" be ſufficient to take off the ſuperfluous
" moiſture. Then take up the paper by
" the two corners of its dry edge, and place
" the wet edge a little beyond the figure on
" the reſinous plate, lowering the reſt of
" the

" the piece gradually till it covers the figure
" without ſliding, then lay over it a piece
" of clean dry paper, and preſs it gently,
" let it remain a ſhort time, and then rub
" it cloſer to the plate with a cloth, or,
" which is better, preſs it down by means
" of a wooden roller covered with cloth,
" taking care that the paper be not moved
" from its firſt poſition. When the paper
" is ſufficiently preſſed, let it be taken up
" by its dry edge, and laid upon the ſurface
" of a veſſel of water with the printed ſide
" downwards, by this means the ſuper-
" fluous powder will ſink in the water, and
" the figure will not be ſo liable afterwards
" to ſpread in the paper. After the paper
" has remained on the water during a few
" minutes, take it up and place it between
" the leaves of a book, removing it fre-
" quently to a dry place. If it be deſired
" that the paper ſhould be ſpeedily dry, let
" the book-leaves in which it is to be
" placed be previouſly warmed, and by re-
" moving it to ſeveral places it will be dry
" much ſooner than by holding it near a
" fire, and without drawing the paper
" crooked. By the above proceſs, it is ob-
" vious,

"vious, that leather, callico, or linen, as "well as paper, may be printed with theſe "figures, and the effects of the diffuſion "of electricity upon a reſinous plate be "exhibited to thoſe who have not leiſure "or inclination to perform the experi- "ments."

Exp. V. A very regular figure may be formed on the ſurface of a reſinous plate by the following means: Lay the reſinous plate upon a table; inſulate one or more pointed wires over the plate, with their points directed towards its ſurface, and at about the diſtance of an inch and a half or two inches. Then by touching thoſe wires alternately with a poſitive and a negative Leyden phial, throw the alternate ſparks upon the reſinous ſurface; and afterwards, by projecting different coloured powders upon the plate, you will obtain very regular figures, conſiſting of concentric zones of different colours, which aſſume the form of circles, ellipſes, or other curves, according as one or more pointed wires are uſed, and according as thoſe wires are placed nearer or farther from each other.

Exp.

Exp. VI. Cut a figure of any ſort out of the middle of a card, as for inſtance a profile, a flower, &c. Place a piece of white ſilk (white ſattin anſwers very well) upon a table; lay the card upon it, and a gold leaf over the card; in which ſituation it is evident that the gold leaf will touch the ſilk only within the limits of the figure that has been cut out of the card. This done, lay another card over the gold leaf, and put a book, or ſomething elſe heavy, upon it to keep it down. Care, however, muſt be taken to leave two projections of the gold leaf out of the card at oppoſite ends. Laſtly, if you ſend the charge of a battery through the gold leaf, by connecting one of its projections with the inſide, and the other with the outſide of the battery, the gold will be melted and forced into the ſubſtance of the ſilk, ſo as to ſtain it with a purple ſpot of the ſhape and ſize of the figure cut in the card. The battery for this experiment muſt have force ſufficient to melt the gold leaf completely. I need hardly obſerve, that by changing the metallic leaf, as well as the figure in the card,

card, many beautiful ornaments may, by this means, be marked upon ſilk.

Exp. VII. Hold a piece of writing paper near the fire to render it dry and warm: then lay it upon a table, and rub it with a dry hand, which operation will electrify the paper. Now light a piece of ſealing-wax with a candle, and after having ſuffered it to burn for about five or ſix ſeconds of time, lift up the excited paper from the table, and hold it up by one corner; blow out the flame of the ſealing-wax, and preſent the melted end of it to the paper at the diſtance of about an inch, moving it in various directions very quickly. In doing this, the electricity of the paper will attract the ſealing-wax into the ſhape of exceedingly fine filaments, which may afterwards be melted and faſtened to the paper, by holding the paper very near the fire for a ſhort time. A ſmall piece of ſealing-wax ſtuck upon a wire or a pin, anſwers better than a common ſtick of ſealing-wax. The impreſſions made in this manner, are in general not ſo beautiful as thoſe deſcribed in the preceding pages; yet this experiment

ment is attended with a conſiderable advantage, which is, that it does not require the electrical machine, or other apparatus, and may of courſe be performed in any place.

the cauſe was confirmed by repeated trials *."

N° III.

THE amalgam of zinc and quickſilver, deſcribed in page 142 of vol. I. is apt to become very hard, eſpecially when left untouched for ſome time; this may be partly prevented by mixing it with a little greaſe, as tallow, or mutton-ſuet, and a very ſmall portion of finely powdered whitening. The proper way of preparing this amalgam is the following: Let the quickſilver be heated to about the degree of boiling water, and let the zinc be melted in a crucible or iron ladle. Pour the heated quickſilver into a wooden box, and immediately after pour the melted zinc in it. Then ſhut the box, and ſhake it for about half a minute. After this you muſt wait until the analgam is quite cold, or nearly

* Read's Summary View of the Spontaneous Electricity, p. 16.

ſo,

ſo, and then you may mix the greaſe with it by trituration.—If the melted zinc be poured into the quickſilver when cold, a very ſmall portion of the former will be amalgamed, the reſt remaining in lumps of different ſizes.

N° IV.

Of the ſuſpected ſpontaneous production of Electricity from living animals.

SEVERAL perſons have ſuſpected, and ſome have even aſſerted their having diſcovered, that living animals generally yield ſome electricity, which, though moſtly poſitive, is however ſometimes negative. Thoſe ſuſpicions and aſſertions, joined to the recent diſcovery of that property of animal bodies which has been called *animal electricity*, induced me to try whether any ſuch ſpontaneous production of electricity could be aſcertained or diſproved; and with this view I made ſome experiments, the reſult of which ſeemed to ſhew, that no electricity

was

ments, and from the analogy of other facts, I am led to believe that the abovementioned ſort of communication might be extended to two or three miles, and probably to a much greater diſtance.

N° IX.

Preparation of the Electrical Amber Varniſh.

IT is well known that glaſs frequently becomes a conductor of electricity, in conſequence of its being apt to attract moiſture from the atmoſphere; to avoid this inconvenience, the makers of philoſophical inſtruments generally cover the glaſs legs and other parts of the electrical apparatus with a coat of ſome non-electric ſubſtance. Sealing-wax and amber varniſh have been principally uſed for this purpoſe. The ſealing-wax has been laid on the glaſs two different ways, viz. either by making the glaſs ſufficiently hot, and then rubbing a piece of ſealing wax upon it, or by firſt diſſolving the ſealing-wax in ſpirit of wine, and then laying

ing it upon the glaſs with a hair pencil*. The firſt of thoſe methods is in my opinion the beſt of any, but it is not practicable with large pieces of glaſs; for, beſides the danger of breaking the glaſs, when a large piece of that ſubſtance has acquired the degree of heat that is ſufficient for the purpoſe, it will retain that heat ſo long as to dry the ſealing-wax too much. With reſpect to the other method, when the ſealing-wax is diſſolved in very highly rectified ſpirits of wine, and the glaſs is previouſly warmed, it will anſwer tolerably well, but it is certainly inferior to the firſt method.

The electrical amber varniſh, when properly prepared, and when carefully laid upon the glaſs, will preſerve its inſulating property full as well as the ſealing-wax, which is applied by means of heat; but the preparation of this varniſh requires a great deal of attention; for if it be not properly made, the glaſs will not be in the leaſt improved

* Some perſons have uſed common ſpirit varniſh mixed with a little vermillion; but this ſort of covering ſerves more for ornament than for uſe, the glaſs being little if at all improved by it.

by

by it; I ſhall therefore be as particular as I can in deſcribing the proceſs, and in pointing out the cauſes which are moſt likely to prevent its ſucceſs.

Preparation of the Amber.

Reduce ſome pieces of amber (the yellow amber is the beſt) into tolerably fine powder, and then melt it in an unglazed earthen veſſel over a charcoal fire;* when melted, pour it whilſt fluid upon an iron plate, and as ſoon as it is become cold, it muſt be pounded and ſifted through a very fine ſieve.

Proceſs for making the Varniſh.

Half a pint of linſeed oil, one ounce of *ſaccarum ſaturni* (ſugar of lead) and one ounce and a half of litharge, muſt be ſet to boil in an iron pot over a charcoal fire. As ſoon as the oil has diſſolved the two

* It muſt not be expected that the amber will melt into as fluid a ſtate as water or oil; for it will hardly acquire the fluidity of cold honey, and therefore it muſt not be kept upon the fire longer than may be neceſſary to produce that effect, otherwiſe it will be burned too much.

other

other ingredients, one ounce and a half of the prepared amber muſt be added, and then the whole muſt be left to boil to a proper degree of conſiſtence. Laſtly, it muſt be mixed with ſuch a quantity of ſpirit of turpentine as will bring it to the conſiſtence of olive oil.—I ſhall now ſubjoin the neceſſary precautions.

The capacity of the boiler ſhould be at leaſt four or five times greater than the bulk of materials, in order to allow for the ſwelling of the compoſition, which is very conſiderable towards the latter end. For the ſame reaſon the boiler muſt be conſtantly watched, and muſt be removed from the fire whenever the liquor comes near the top; for if any of it happen to run over, it will take fire immediately. The mixture ſhould be ſtirred every two or three minutes, but towards the latter end, viz. after it has boiled for about two hours, it ſhould be ſtirred oftener. An iron ladle is very fit for this purpoſe.

The conſiſtency of the liquor ſhews when it has boiled ſufficiently; for if at

that

that time a drop of it be rubbed between two knife-blades, and the blades are afterwards ſeparated, the varniſh will ſtretch itſelf like a continued thread from one blade to the other. When this effect takes place, the pot may be removed from the fire, and left to cool, but before it becomes quite cold, the ſpirit of turpentine muſt be mixed with it. The beſt way of forming this mixture is to put the ſpirit of turpentine into a baſon or pipkin, then to add one ladle full of the varniſh at a time, and to ſtir it until it is quite diſſolved in the ſpirit. The varniſh may then be put in bottles, and kept for uſe.

If the compoſition has been boiled too much, the colour of the varniſh, when mixed with the ſpirit of turpentine, inſtead of a browniſh yellow, will be dark brown; and if it has not been boiled ſufficiently, the varniſh, when laid upon the glaſs, will always retain a degree of clammineſs. This clammineſs is likewiſe produced when the litharge and the ſaccarum ſaturni are not very dry; it will therefore be proper to dry thoſe articles thoroughly

thoroughly previous to their being mixed with the oil.

This varniſh is laid upon the glaſs by means of a hair pencil, and one coat of it is quite ſufficient to preſerve the inſulating property of glaſs; but care ſhould be had to render the glaſs perfectly clean and dry, and to warm it previouſly to the application of the varniſh.

If the varniſh has been rightly prepared it will dry very ſpeedily; but for greater ſecurity it will be adviſeable to leave the varniſhed glaſs in a dry place for a day or two in the ſummer ſeaſon, and a little longer in the winter.

As ſome ingenious perſons may be in want of the beſt inſulating ſubſtances for nice electrical experiments, I think it not uſeleſs to mention, that raw ſilk poſſeſſes that property in a very eminent degree, even in damp and rainy weather. This ſubſtance, therefore, ſhould be preferred to all others, when ſtrength and pliableneſs

is

is required; otherwiſe ſealing-wax and amber anſwer equally well.

Silks that have undergone the proceſs of dying, or even of bleaching, though they inſulate ſufficiently well for common experiments, are, however, inferior to raw ſilk.

Quickſilver excites glaſs negatively.

N° X.

Addition to Page 35 *of this Volume.*

" I find that Mr. FONTANA obſerved the action of the metallic application upon the heart a conſiderable time before Dr. FOWLER. In a letter to Mr. MARSIGLI, dated in November, 1792, which was printed at Pavia in a periodical publication, Mr. FONTANA, expreſſes himſelf thus, " Relativement au mouvement du " cœur, je puis aſſurer, qu'il eſt facile d'ac- " celerer ſes battemens s'il eſt en mouve- " ment, & de le remettre en mouvement " s'il eſt en repos. Il ſuffit de le placer " entre deux métaux, par example, le zinc

" & l'antimoine, de manière à ce qu'une " partie de ce muſcle touche à l'un des " metaux, & l'autre partie à l'autre metal. " En faiſſant alors communiquer les deux " metaux au moyen d'un conducteur, on " verra s'effecteur les phénomènes que je " viens d'indiquer, meme lorſque le cœur " eſt ſeparé du corps & coupé par mor- " ceaux. Je puis encore aſſurer que je fais " contracter à volonté les vers de terre, " les inſectes, & les animaux privés de cer- " veau & de nerfs. Sous peu de tems je " publierai un ouvrage ſur le nouveau " principe du mouvement muſculaire, de- " couvert à Bologne par le ſavant profeſſeur " GALVANI, & j'eſpère demontrer d'une " maniere rigoureuſe, que ce principe n'a " rien de commun avec l'electricité, & que " quel qu'il ſoit, il n'opère jamais la con- " traction, ni ne reproduit jamais les mouve- " mens muſculaires ordinaires aux animaux. " Ainſi ce principe obſcur eſt réduit à un " phénomène très-beau, mais dont la na- " ture & les uſages reſtent encore à de- " terminer *.

* See the *Journal de Phyſique* for March 1793.

N° XI.

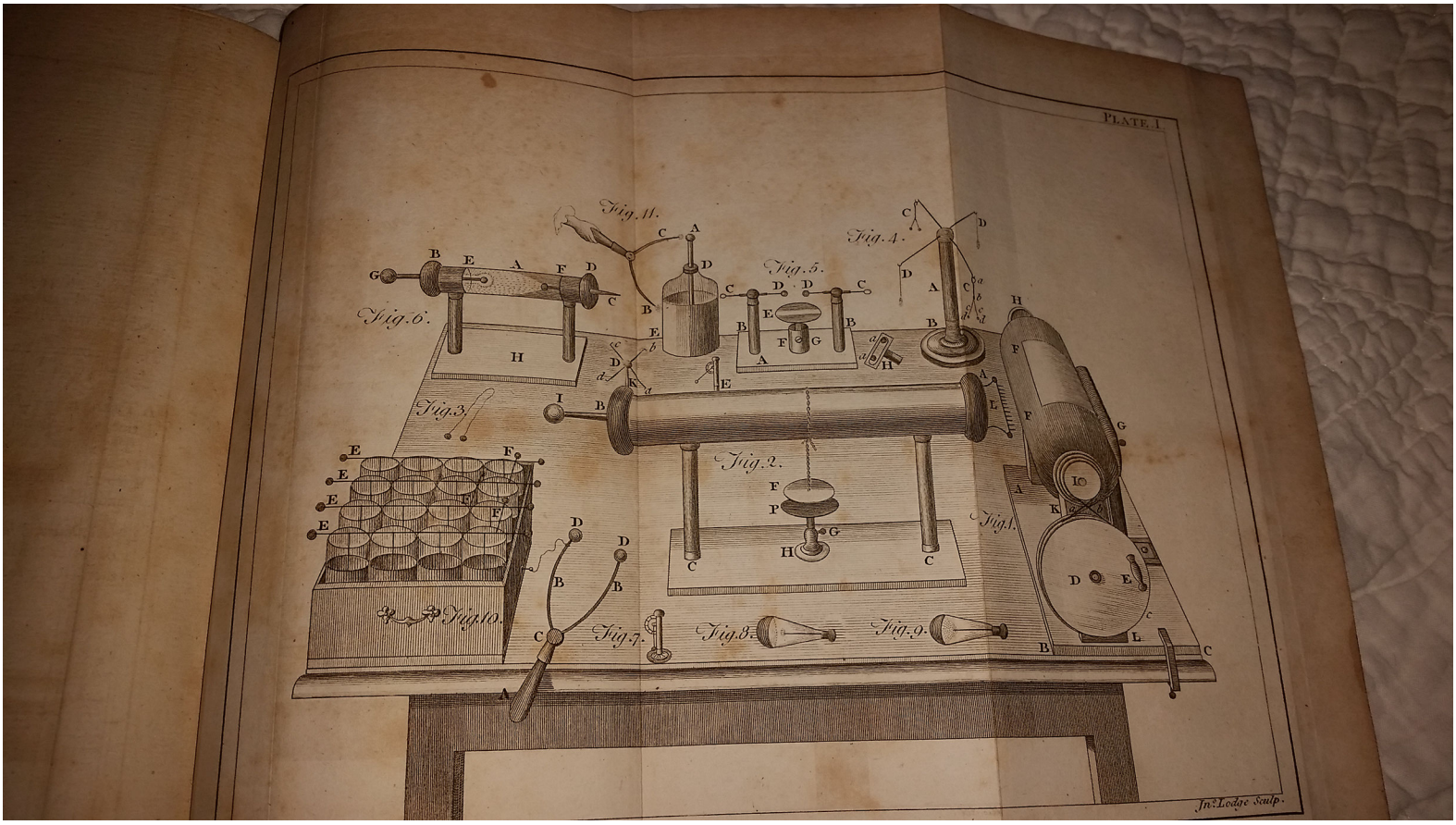
PLATE. I.
Fig. 11.
Fig. 4.
Fig. 5.
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Fig. 2.
Fig. 1.
Fig. 10.
Fig. 7.
Fig. 8.
Fig. 9.
Jn.o Lodge Sculp.

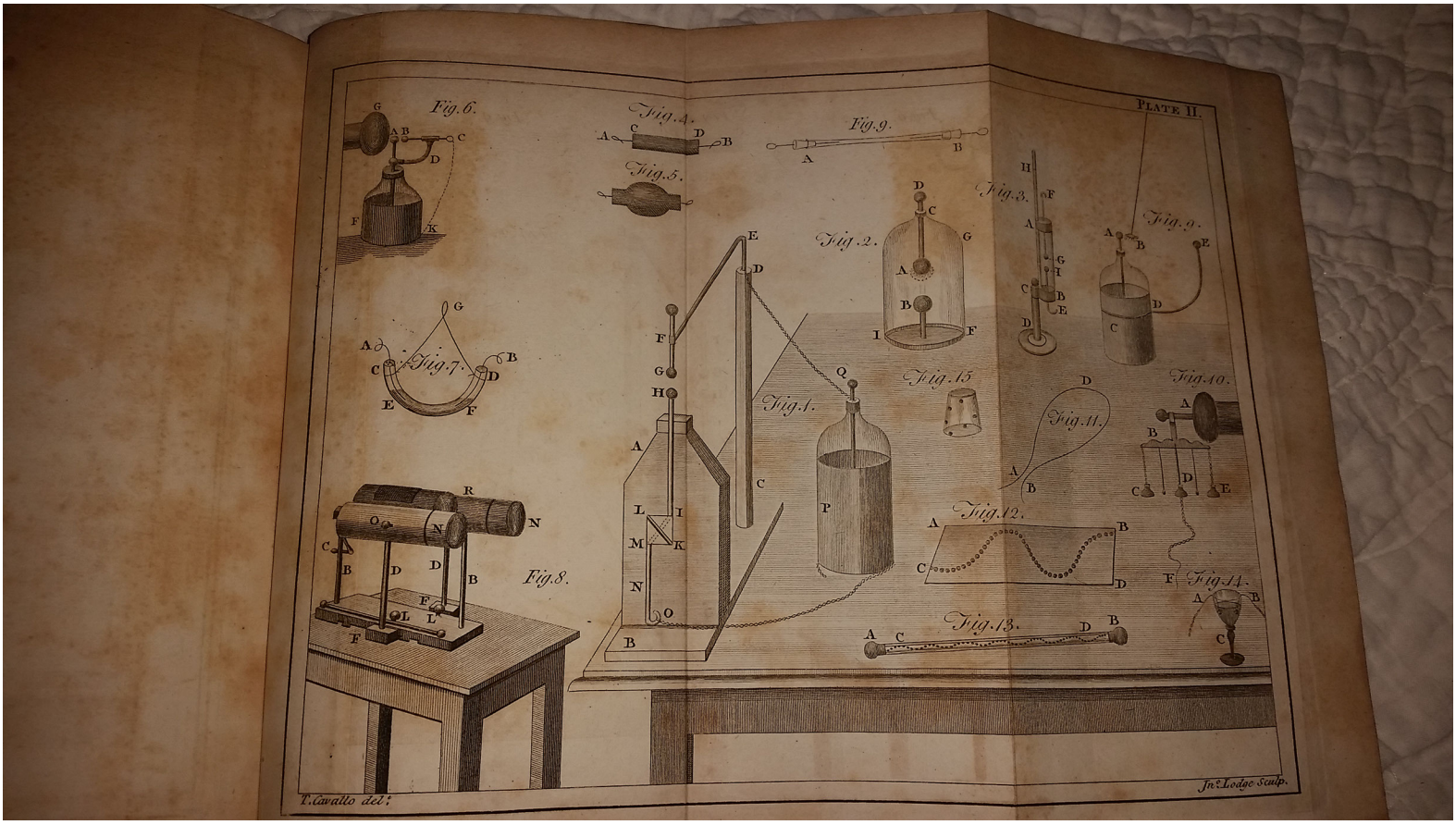
PLATE II.
Fig. 6.
Fig. 4.
Fig. 5.
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Fig. 3.
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Fig. 15
Fig. 10.
Fig. 11.
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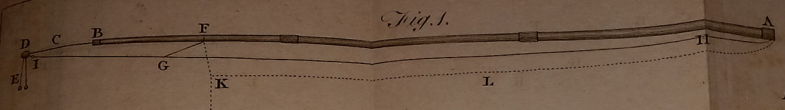
Fig. 13.
Fig. 14.
T. Cavallo del.
Jn.e Lodge Sculp.

PLATE III.

Fig. 1.



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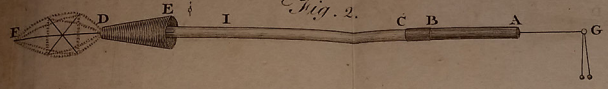

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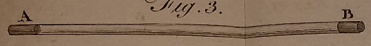
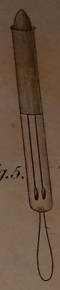


Fig. 4.

Fig. 5.



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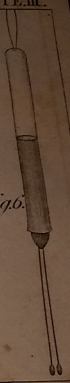

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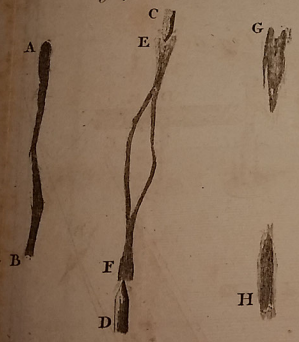

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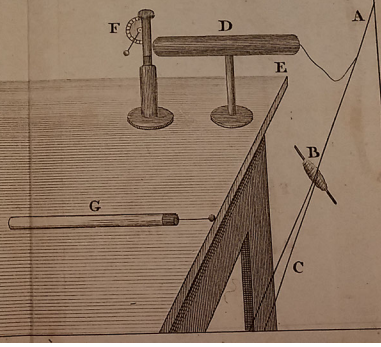

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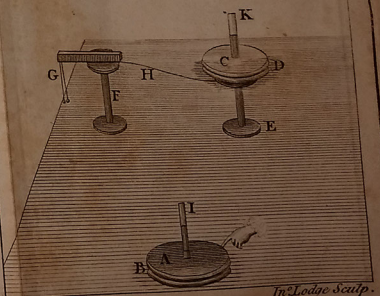

Jn.ᵗ Lodge Sculp.

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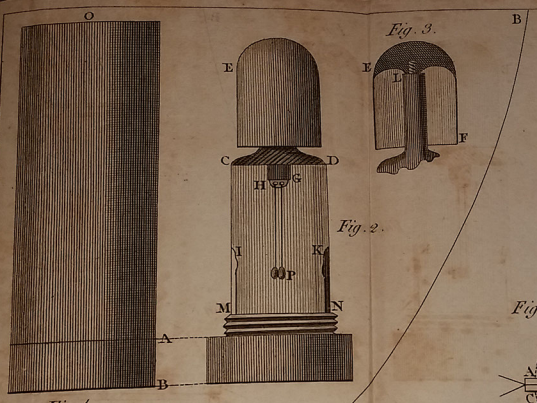

Fig. 1.

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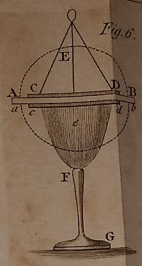

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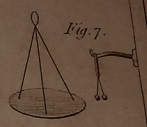

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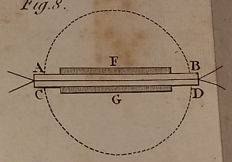

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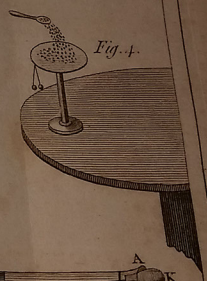

Fig. 4.

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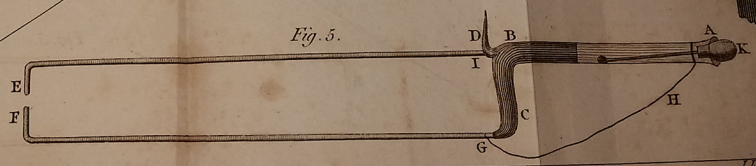
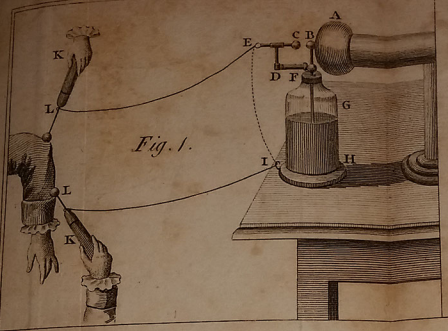


Fig. 5.

T. Cavallo del.

J. Lodge sc.

PLATE I.



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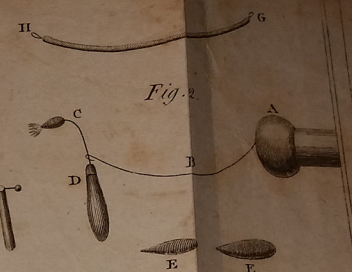

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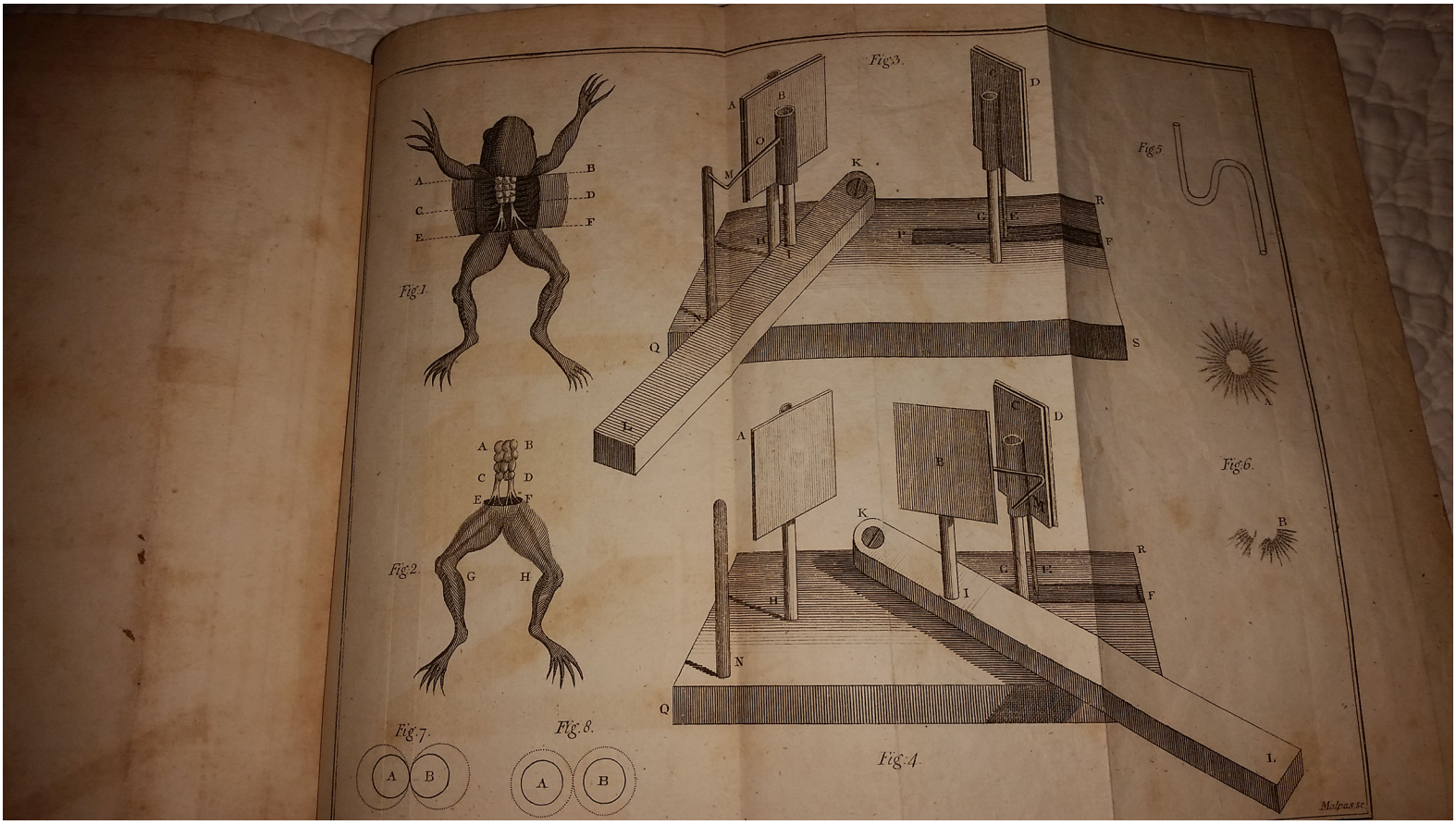
Fig.1.
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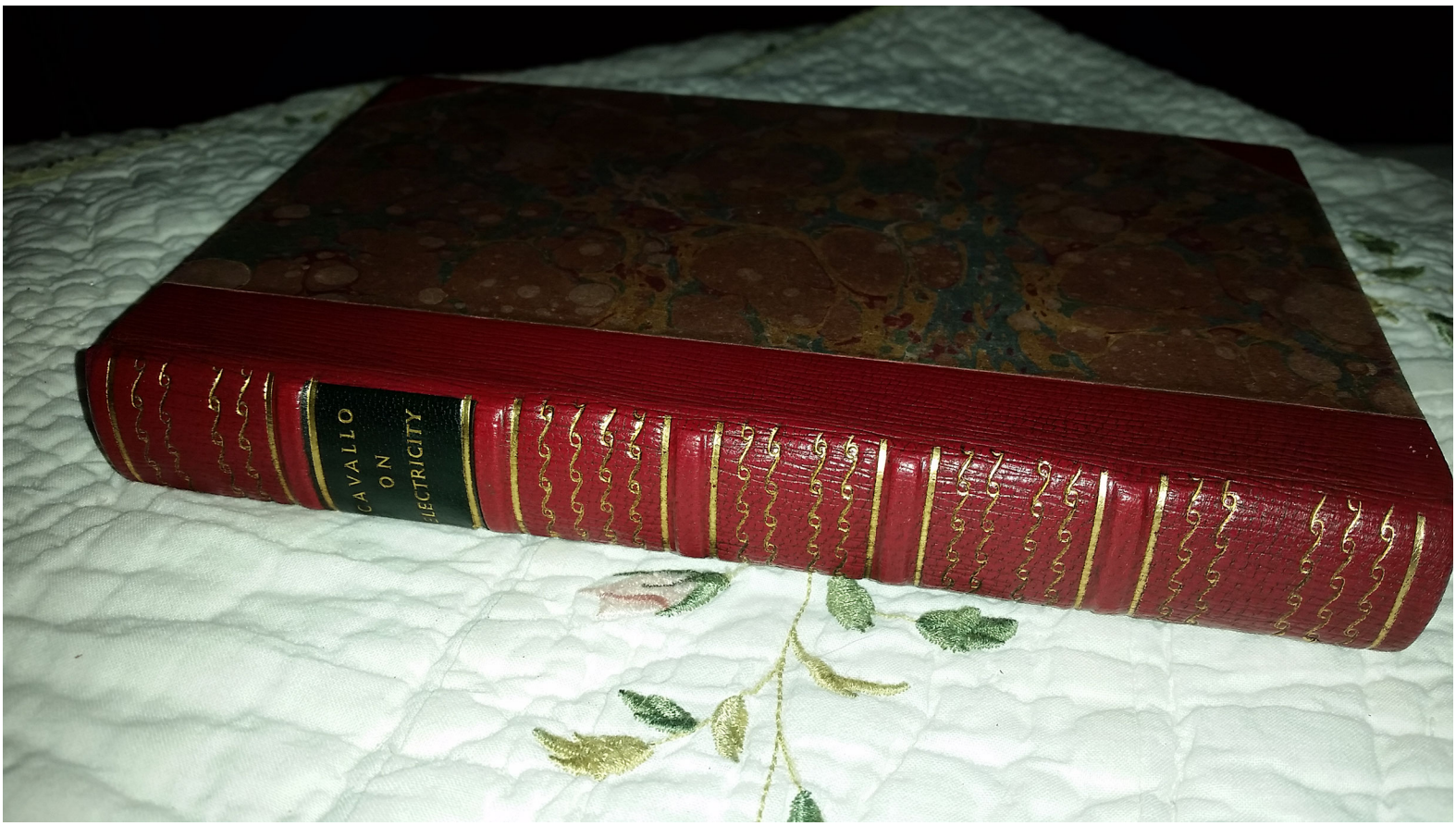
CAVALLO
ON
ELECTRICITY

A

COMPLETE TREATISE

ON

ELECTRICITY,

IN

THEORY AND PRACTICE;

WITH

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By TIBERIUS CAVALLO, F.R.S.

IN THREE VOLUMES.

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